Social, economic, and ecological impact assessment across marine sectors?

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Publication date:
2015

Document Version
Publisher's PDF, also known as Version of record

Theme session M

Social, economic, and ecological impact assessment across marine sectors?

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Introduction and background

Marine ecosystems evolve under many inter-connected and area specific pressures originating in natural and anthropogenic changes, which are increasing in magnitude and intensity of human pressures that cumulatively affect the seas. The means and systems for more effective planning of marine space and broader scale management of marine resources must be provided that fulfil the intensifying and diverse needs from society, while ensuring that development is ecologically sustainable. These needs include traditional and intensively exploited goods and services such as fishing, aquaculture, renewable energy, shipping, and recreation. There are diverse and competing interests, and accordingly competition across, marine sectors for the multitude of uses for marine resources and where they occur in space. Therefore, there is an urgent need to elaborate and apply common principles and broader management evaluation to the use of marine space. Policy-makers in particular need to know the costs and benefits of ecosystem goods and services protection to manage them sustainably. Region specific pressures, affiliated uncertainties, and risks need to be taken into account. Increasing pressures from eutrophication, climate change, and pollution also needs to be considered in this context. Some pressures may be managed on local levels but many are trans-boundary in nature, and therefore, require a regional management approach. Furthermore, national activities may have trans-boundary effects on the ecosystem as a whole. Understanding the linkages between structure and functioning of the sea ecosystem and various human activities from local to regional scales is critical here. Long-term strategic management, applying the ecosystem approach to management, is closely linked with regional sustainable development. This necessarily involves proper harmonization of a) ecological, b) economic, and c) social factors accompanied by overarching considerations of the appropriate governance for development to continue without degrading ecosystem goods and services, in particular those, which maintain viable sectors. This essentially requires development and implementation of more comprehensive, integrated, and holistic approaches (on a case specific basis) to understanding, anticipating and analysing ecological, economic and social change on a regional scale. The approaches must offer the possibility to conduct assessments in a multidisciplinary and regional context, and to develop appropriate adaptive and mitigation responses both locally and regionally.

Aim of the session

The major aim with the session is to enhance implementation of broader scale impact assessment of fishery and other maritime sector use in ecological, economic and socio-economic perspectives where fisheries management considerations are fully integrated with other marine sectors. The need is increasing for integrating ecological and economic analysis and advice for managing fisheries and other marine resources. To meet this need integrated ecological-economic models and evaluation methods will

need to be further developed. Doing so, will require exploration of how to better communicate advice generated by integrated models and how various characteristics of models affect their usefulness for informing different types of decisions.

The papers called for to the session were within the following topics:

- integrating fisheries management into maritime spatial planning and broader cross sector marine management – implications and needs?
- integrating economic-social-ecological marine cross sector and fisheries management evaluation models and methods – challenges in implementation: how are models used, what improves or impedes their acceptance, what makes a model informative and useful to policy-makers and stakeholders, how can we best communicate model structure and meaning of model outputs to decision-makers, what are the needed characteristics for the use of models in advisory context -tactical/strategic and complexity/flexibility/user-friendliness and robustness/risk assessment?
- integrating spatially explicit and cross national regional management evaluation methods – worldwide experiences
- spatial management strategies accounting for ecological, economic and social sustainability and viability needs for future research, development and advisory structures

Contributions to the session:

The contributions to the session can be divided into two major categories, which generally were reflected in the sequence of the presentations during Session M at the ASC. One category was about ecological-economic or bioeconomic models, i.e. development and implementation of integrated ecological and economic models (bioeconomic models) used in relation to management strategy evaluation. The other category covered a mixture of empirical analysis, valuation studies, and more general discussions and perspectives. The cohesion between the presentations in the latter group was not high. However, they all fitted well into the rather broad special session description above.

One modelling topic (M:02, M:03) covered new developments of bioeconomic agent based methods with implementation of individual vessel based models to evaluate economic and ecological affects of fisheries management scenarios, e.g. effort reallocation according to closures or gear specific interventions to reduce benthic affect or discards in fisheries conducted with large vessels with VMS monitoring systems. These simulation models are capable of performing management strategy evaluation with very high spatial resolution. They also include economic affect evaluation as well as energy efficiency for different métiers and fleets along with evaluation of ecological sustainability for stocks given spatial-temporal patterns in underlying resource availability. This can be integrated in broader marine spatial planning and which involves learning abilities and adaptive strategies. Furthermore, some models are capable of integrating biological interactions between stocks through dynamic coupling to multispecies models or ecosystem models. Individual agent based and high resolution information such as electronic logbooks from fishers are also used in an indicator-based sustainability assessment tool (M:14) to inform fishers (stakeholders) about their performance according to scores on a set of environmental,

social and economic sustainability indicators for each fishing trip to evaluate effects of different behaviour.

Other bioeconomic models presented also integrate fisheries behaviour and they can evaluate and forecast economic affect on fisheries of management measures and how fisheries (multiple fleets) react to constraints from regulations. One example is use of a spatial explicit model with evaluation of discard bans (M:05) by use of profit maximization under consideration of spatial-temporal patterns in a mixed fishery and underlying fish resources given ecological sustainability of fish stocks assessed through a stochastic age based population model. Other non-spatial explicit examples, include evaluation of trade-offs in input controls and bycatch of protected species (M:08) by maximizing the co-viability probability under multiple constraints to assess the optimal fleet capacity conditional on economic efficiency and biological sustainability and diversity including sea snake conservation. Under this category is also evaluation of discard ban, bycatch , and quota uptake under catch quota management with rights based systems (ITQs) in a mixed fisheries system (M:11) where the modelling determines whether a discard ban entails greater variability of economic returns within and between fleets in the short term. Catch quota management in relation to discarding in mixed fisheries is also evaluated in another study (M:01) drawing on a principal-agent model with empirical data analysis to investigate whether average gross income increases under catch quota management compared to conventional rules. Another non-spatial bioeconomic model (M:04) evaluates different quota allocation scenarios between fleets in mixed fisheries according to fleet behaviour, fleet capacity, economic performance, and fish stock sustainability.

A third integrated modelling topic is the broader end-to-end modelling frameworks that allows the whole of ecosystem climate, eutrophication, and spatial management scenario exploration (M:12) where the ecosystem model is linked to a high resolution spatial-temporal physical-bio-geo-chemical model and to a bioeconomic fisheries model. Such frameworks take into account biological interactions and trophic dynamics and can investigate ecosystem responses and changes in fish and fishery production according to changes in human induced pressures by simulating different eutrophication and fisheries scenarios. Different spatial aspects in biological interactions between species has also been addressed in a study comparing different fish stock–recruitment relationships with spatially explicit time-series of environmental variables (M:13).

Overall, different types of integrated ecological and economic models have been reviewed with respect to their potential to evaluate management actions and understand, and anticipate ecological, economic, and social dynamics at a range of scales from local to national and regional (M:10). To make these models most effective, it is important to determine how model characteristics and methods of communicating results influence the nature of the advice that can be provided and the affect on decisions taken by managers. The global review makes a comparative evaluation of integrated models applied to marine fisheries and marine ecosystem resources according to a broad set of criteria to identify the characteristics that determine their usefulness and effectiveness.

Social indicators including employment have been established to be used in evaluation of affects of fish stock multi-annual management plans (M:17) using integrated modelling and assessment of the biological, economic and social consequences of implementing various management options.

A non-modelling broader perspective study (M:18) considered use of hierarchy theory to select appropriate questions (criteria) in multi-sector assessments to address system responses to drivers and pressures at different spatial and temporal scales. Another approach is to use an operational interdisciplinary tool to assist and guide cost-efficient policy and governing responses to marine resources crises (M:09), i.e. using a framework for assessment of effective or non-effective governance response. A study with theoretical considerations in relation to a Baltic fishery indicates that effort management may be an effective input based management tool (M:19).

Finally, cross sector evaluation and marine spatial planning has been addressed in a number of studies belonging to the category of non-modelling presentations. This covers coastal zone and open sea management with interview and questionnaire evaluations of ecosystem goods and services and trade-offs in relation to a) willingness to pay for good ecological status in coastal zones in Northwest Portugal (M:06) and b) in spatial use and closures with respect to commercial fishery compared to recreational use and tourism in Azores waters (M:15, M:16) under consideration of ecological, economic and social sustainability.

Conclusions

Given the above topics and coverage in the presentations the Theme Session M successfully addressed the following science priority areas: 18 Identify objectives for IEAs that address ecosystem stability and health, taking cognizance of ecological, social, and economic sustainability goals as well as multi-scale issues, 23 Use EIAs to assist in informing management about the effects of cumulative pressures and additive and non-additive affects, and which provide risk evaluations and analyses of trade-offs between sector objectives; 24Compare IEA and single-issue approaches regarding their efficacy in providing management and governance advice on sectoral and multi-sectoral use of the oceans.

The theme session and its presentations show that significant progress have been made within integrated management evaluation, but also that further research is needed within the respective topics and areas to allow addressing the increased management demands and to fully implement different management evaluation methods. Accordingly, the session has contributed well to new knowledge within this expanding research area and pointed at necessary new developments in order to improve fisheries and marine management and marine spatial planning.